Professor's Page

IS UNDERSTANDING A PROFICIENCY?

"The proficiency strands describe the actions in which students can engage when learning and using the content. While not all proficiency strands apply to every content description, they indicate the breadth of mathematical actions that teachers can emphasise." (Australian Curriculum Assessment and Reporting Authority (ACARA) 2011)

Mike Askew
Professor of Primary Education, Monash University

I like this quote from the *Australian Curriculum: Mathematics*; firstly, because it describes the mathematical proficiencies as actions and, secondly, for drawing our attention to the idea that learners need to enact the proficiencies when learning mathematics and not just when applying it. Just in case you haven't yet learnt the *Australian Curriculum: Mathematics* by heart, a reminder that the four proficiencies are fluency, reasoning, problem solving and understanding.

The everyday use of 'proficient' carries connotations of having reached a level of expertise; my edition of the Oxford dictionary gives the definition as "Proficient (adjective): adept, expert" (with Proficiency labelled as an adverb). We would not describe someone stumbling through a rendition of "Chopsticks" as a proficient piano player; but novice pianists work on musical proficiencies—practicing scales or playing a polka—in parallel. They do not put off playing the polka until they can play scales fluently.

Like learning to play the piano, becoming mathematically proficient means engaging in certain actions even before one displays full competence with these actions. Becoming a proficient mathematician means working with all of the proficiencies from the beginning—and by 'mathematician,' here I mean anyone using mathematics in his or her life. Everyone is a mathematician.

This challenges the popularly held view (myth even) that children first become fluent in adding, creating equivalent fractions, naming shapes, or whatever and only then can apply this to solve problems, or reason about it. We need continuously to challenge this 'fluency first' view as otherwise building the other proficiencies into mathematics lessons may be put off to some later (and again often mythical) time when learners are 'ready' to engage with them.

In other words, taking the stance of the proficiencies as actions means moving from seeing school mathematics as a body of knowledge for learners to acquire, to seeing it as an activity to engage in; or, in the words of Brent Davis, moving from seeing mathematics as preformed to mathematics as performed.

Performing proficiencies

So what do these proficiencies look like in action? ACARA documents several examples:

Fluency:

- choosing and carrying out procedures,
- recalling factual knowledge and concepts

So far, so good. I can engage learners in the action of choosing between procedures and observe them doing so. I can see whether or not they can recall things (when appropriate), like multiplication facts or names of quadrilaterals.

Problem solving:

- making choices
- interpreting, formulating, modeling and investigating problems situations,
- communicating solutions

Again, active verbs that I can imagine learners doing and could observe in action.

I can see what choices learners make in how to turn a problem into a mathematical model, and communicating solutions has to be done for someone, which I can also observe.

Reasoning:

- analysing
- proving
- evaluating
- explaining
- inferring
- justifying
- generalising.

More good, strong, observable verbs. A child who conjectures that adding two odd numbers must always be even might justify this by some sketches showing how each odd number can be drawn as having a 'one' sticking out and so putting them together makes them fit to make an even number. Good observable stuff.

Understanding

- Building robust knowledge of mathematical concepts.
- Making connections between related ideas.

At first glance these look like actions: building, making, describing. But what does building 'robust knowledge' or making 'connections between ideas' look like? I can see what people are doing when building, say, a robust tower or constructing connections between riverbanks, but can I actually observe the actions of building knowledge or making connections? I can only see the results of this. Children can demonstrate that they have made connections, that they have built knowledge, but these are the result of internal process that I cannot directly observe. OK, perhaps I chose poor examples. What others can I find?

- Describing their thinking
- Develop an understanding of the relationship between the 'why' and the 'how' of mathematics.

Describing their thinking—that is an action I can both encourage and observe. But how does that differ from the 'explaining' or 'justifying' in the reasoning proficiency? Or the 'communicating solutions' in problem solving?And to say that an action of understanding is to develop an understanding is, well… taking us round in circles.

Is understanding a proficiency?

I have difficulty describing 'understanding' as an 'action'—I can develop understanding, I can demonstrate understanding, but I am not clear how I 'do' understanding. If I make a connection between, say, decimal fractions and place value, isn't that likely to be an outcome of engaging in some problem solving and reasoning about the relationship? I prefer to think of understanding as the result of doing the other proficiencies—engaging in problem solving, reasoning about the 'why' of mathematics and being fluent in the 'how' of mathematics provide the building blocks of understanding. A bit like nourishment: I can buy food, prepare it, eat it and digest it. Yes, digestion is an action, but it is of a different order to the first three, particularly in the degree of control that I, or others, have over it.

I am not the only one to take this position. Ron Ritchart and colleagues from the Project Zero team, in their analysis of thinking, arrive at the position of "understanding not to be a type of thinking at all but an outcome of thinking" (2011). Arguing along similar lines, Wiske (1997) concludes that "understanding is not a precursor to application, analysis, evaluating and creating but a result of it."

I am inclined to this latter view—paying attention in mathematics lessons to a good balance of the actions involved in fluency, problem solving and reasoning will lead to connected, robust, related understanding.

It's great that the proficiencies highlight understanding but let's hope that it does not get sidelined if teachers find it difficult to turn it into actions.

References

Australian Curriculum Assessment and Reporting Authority (ACARA) (2011). *The Australian Curriculum: Mathematics F–10.* Canberra: ACARA.

Ritchart, R., M. Church, et al. (2011). *Making thinking visible.* San Francisco: Jossey-Bass.

Wiske, M. S., Ed. (1997). *Teaching for understanding.* San Francisco: Jossey-Bass.